What is claimed is:

CLAIMS

1. A communication apparatus for high-speed data transmission over power line networks comprises:

a head-end unit which provides a single logical entry point into the communication network;

an infrastructure of physical power line cables;

one or more client-end units which communicate with the head-end unit;

one or more hybrid units which simultaneously:

acts as a head-end unit for another physical sub-network of the power line communication network, and

functions as a client-end unit of another physical sub-network of the power line communication network;

2. All physical devices on the power line network are assigned a globally unique hardware address.

3. The logical full-duplex communication channel between the head-end and client-end units is comprised of:

a logical half-duplex downstream communication channel, in which the modulator frequency of the head-end unit's transmitter is matched by the demodulator frequency of the every client-end unit associated with the head-end unit on the same physical power line sub-network, and

a logical half-duplex upstream communication channel, in which the modulator frequency of each client-end unit is matched with the demodulator frequency of the head-end unit;

4. The downstream and upstream frequency channels are mutually exclusive.

5. The bandwidth of the downstream communication channel may be identical or different from the bandwidth of the upstream communication channel;

6. The bandwidth between the head-end unit and client-end units with matching frequency pairs is defined by the sum of:

the bandwidth of the frequency band of the downstream channel, plus

the bandwidth of the frequency band of the upstream channel;

7. To increase the total capacity of the power line network, multiple frequency pairs may be overlaid on the same transmission medium, such that:

all downstream frequency bands are mutually exclusive and non-interfering,

all upstream frequency bands are mutually exclusive and non-interfering,

all full-duplex communication frequency bands are mutually exclusive and non-interfering.

8. The bandwidth of each half-duplex communication channel between the head-end unit and one or more client-end units is divided into one or more transmission time slots, such that:

all time slots are assigned equal bandwidth,

all time slots are sequentially numbered starting from 0,

the bandwidth of each time slot defines the maximum data size and burst rate any node can transmit at any given time.

9. The total bandwidth of each half-duplex communication channel is defined as the product of the bandwidth of each time slot and the total number of time slots.

10. A device on any given physical sub-network of the power line communication network may transmit data only if:

its carrier sensing sub-system positively detected a valid carrier (head-end units are excluded from this restriction), and

its time allocation resource map permits data transmission at the given time slot.

11. The head-end unit broadcasts all downstream data to all client-end units on the same logical sub-network.

12. The head-end unit in this communication apparatus defined in claim 1:

may transmit data at any given time slot,

is responsible for generating the resource allocation maps for each registered client-end unit,

is responsible for registering new client-end units,

is responsible for detecting inactive and extracted client-end units.

13. Client-end units perform frame selection/discard locally, in parallel, based on the following algorithm:

each client-end unit must examine the destination hardware address of the data frame received from the head-unit, and

if the destination hardware address matches with its own hardware address, the frame is scheduled for processing,

otherwise the frame is discarded.

14. A client-end unit may transmit data if, and only if:

it has received its time slot allocation map from the head-end unit, and

its time slot allocation map permits data transmission at the given time.

15. Time slots on the upstream channel are assigned to be mutually exclusive for all client-end units. This guarantees that the upstream traffic is collision free.

16. One or more time slots are reserved to allow new devices (which have not been assigned any resources) to send registration information to the head-unit.

17. The medium access control sub-system for the communication apparatus in claim 1, must comply with the following algorithms:

new client-end devices to be inserted into the active network must:

passively monitor the resource allocation and time slot configuration periodically broadcasted by the head-end unit, and

if the received configuration contains a valid time slot allocation for the given client-end device, this information must be applied immediately, and the client-end device may begin to transmit upstream data at the allowed time slots;

otherwise, if after a configurable timeout period, the client device does not receive any configuration containing a valid time slot allocation for the given client-end device, the client-end device may send a registration request over the reserved time slot in claim 16.

devices that are to be extracted from the power line communication network may:

send an explicit un-registration request to the head-end unit over any time slot currently assigned to the client-end device, or

terminate communication without sending an explicit un-registration request to the head-end unit.

all active client-end devices on the power line communication network must:

continuously monitor downstream traffic for time slot allocation updates from the head-end unit, and

incorporate any configuration change immediately after reception.

any active client-end device on the power line communication network must:

continuously monitor downstream traffic for explicit termination messages from the head-end unit, and

discontinue all transmission and enter its initialization phase immediately after reception or this message.

18. Time slot resources may be assigned either:

a prescription based allocation scheme, where:

the amount of bandwidth allocated to an individual client-end unit is based on a pre-defined subscription rate, plus

any unused resources not subscribed to may be temporarily allocated to active subscribers with the following constraints:

the additional bandwidth may be revoked at any time, without notice by the head-end unit,

the total allowable throughput of the client-end device may not exceed the sum of the subscribed and temporary allocated bandwidth.

an evenly distributed bandwidth allocation scheme, where:

every client-end device receives an equal share of the total time allocation resources,

time allocation resources are dynamically assigned,

a dynamically assigned un-even resource allocation scheme, where:

every client-end device receives a time slot allocation based on a pre-set resource allocation algorithms,

time allocation resources are dynamically assigned,

19. The protocol frame format is designed to allow virtually any type of payload to be carried across the power line communication network.

20. The protocol frame format is composed of (but not limited to) the following required fields:

a length field, which identifies the number of octets in the payload of the frame,

a media selector field, which identifies the type of payload,

a cyclic redundancy check (CRC) field, which contains the CRC value calculated over the reaming portion of the frame,

an arbitrary sequence of data, which represents the payload of the frame.

21. The communication apparatus in claim 1 over the power line network is currently designed (but not limited to) for supporting the following applications:

internet data for local, medium, and wide area networks, including but not limited to:

ethernet (IEEE 802.3) frame forwarding,

wireless LAN (IEEE 802.11) frame forwarding,

internet protocol (IP) packet forwarding, address translation, and packet filtering,

token bus (IEEE 802.4) frame forwarding,

token ring (IEEE 802.5) frame forwarding,

telephone and digital voice packet forwarding, and SS-7 digital signaling interface message forwarding and processing,

digital video transmission frame forwarding and processing,

digital television and cable service data forwarding, command message relay, and processing,

automatic meter reading (AMR) message forwarding and processing.